

Paint Rock River Embayment Wheeler Reservoir Intensive Basin Survey 2015

WHEL-1: Paint Rock R approx 1 mi upstream of confluence with TN River (Madison Co 34.48325/-

BACKGROUND

The Alabama Department of Environmental Management (ADEM) began monitoring lake water quality statewide in 1985, followed by a second statewide survey in 1989. In 1990, the Reservoir Water Quality Monitoring Program [now known as the Rivers and Reservoirs Monitoring Program (RRMP)] was initiated by ADEM.

The current objectives of this program are to provide data that can be used to assess current water quality conditions, identify trends in water quality conditions and to develop Total Maximum Daily Loads (TMDLs) and water quality criteria. Descriptions of all RRMP monitoring activities are available in ADEM’s 2012 Monitoring Strategy (ADEM 2012).

In 2015, ADEM monitored the Paint Rock River tributary embayment of Wheeler Reservoir as part of the basin assessment of the Tennessee River under the RRMP. This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the Paint Rock River embayment (WHEL-1) during the 2015 growing season (Apr-Oct). This is the fourth basin assessment of the Tennessee River since ADEM began sampling. Monthly and/or mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [chlorophyll *a* (chl *a*); algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)], and trophic state [Carlson’s trophic state index (TSI)] from 2015 were compared to ADEM’s historical data and established criteria.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Paint Rock River is classified as a *Fish & Wildlife (F&W)* stream located in the Plateau Escarpment ecoregion (68c). Based on the 2006 National Land Cover Dataset, land use within the 459 mi² watershed is predominantly forest (73%) (Fig. 3). As of January 28, 2016, ADEM has issued a total of 29 NPDES permits within the watershed. Two of those permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

The Paint Rock River embayment at WHEL-1 is a fairly small, riverine embayment flowing into the Tennessee River near river mile 344. Paint Rock River has a mean bottom depth of 4.68 m (Table 2) at the sampling location.



Figure 1. Photo of Paint Rock R at WHEL-1.

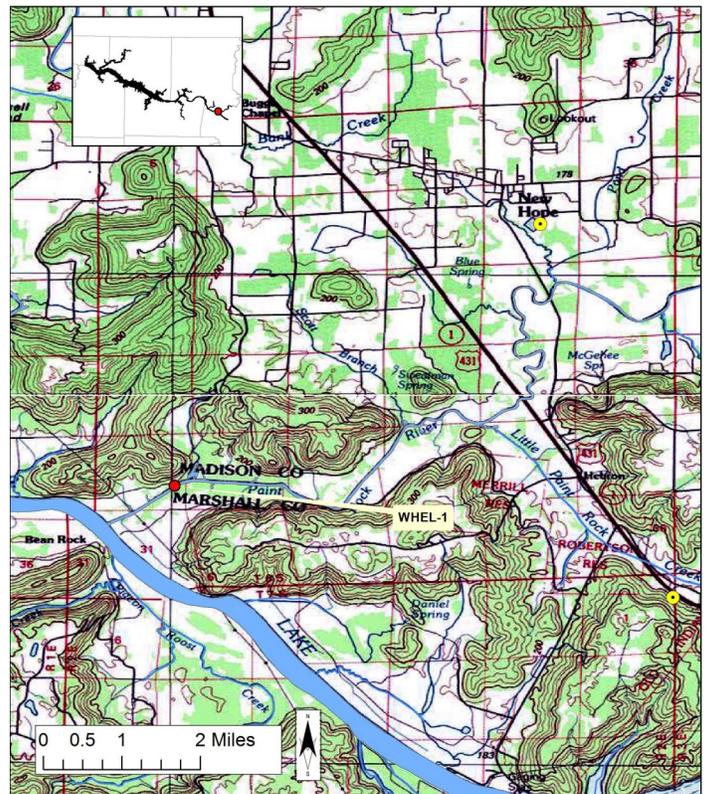


Figure 2. Map of Paint Rock River embayment of Wheeler Reservoir. Though additional permitted facilities may occur in the watershed (Table 1), only those within 10 miles upstream of the station are displayed on the map.

METHODS

Water quality assessments were conducted at monthly intervals, April-October. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2015), Surface Water Quality Assurance Project Plan (ADEM 2012), and Quality Management Plan (ADEM 2013).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions. Monthly concentrations of these parameters were graphed with ADEM's previously collected data to help interpret the 2015 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

RESULTS

The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2. The axis ranges of the graphs in Figs. 4-6 were set to maximum values reservoir-wide so all embayment reports on the same reservoir could be compared.

Basin	Tennessee R
Drainage Area (mi ²)	459
Ecoregion ^a	68c
% Land use	
Open Water	<1%
Developed	Open Space 2%
	Low Intensity <1%
	Medium Intensity <1%
	High Intensity <1%
Barren Land	<1%
Forest	Deciduous Forest 69%
	Evergreen Forest 1%
	Mixed Forest 3%
	Shrub/Scrub 4%
	Herbaceous 1%
	Hay/Pasture 12%
	Cultivated Crops 6%
	Wetlands Woody 2%
	Emergent Herb. <1%
# NPDES outfalls ^b	TOTAL 29
	Construction Stormwater 15
	Mining 4
	Industrial General 7
	Municipal 3

a. Plateau Escarpment

b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Jan 28, 2016.

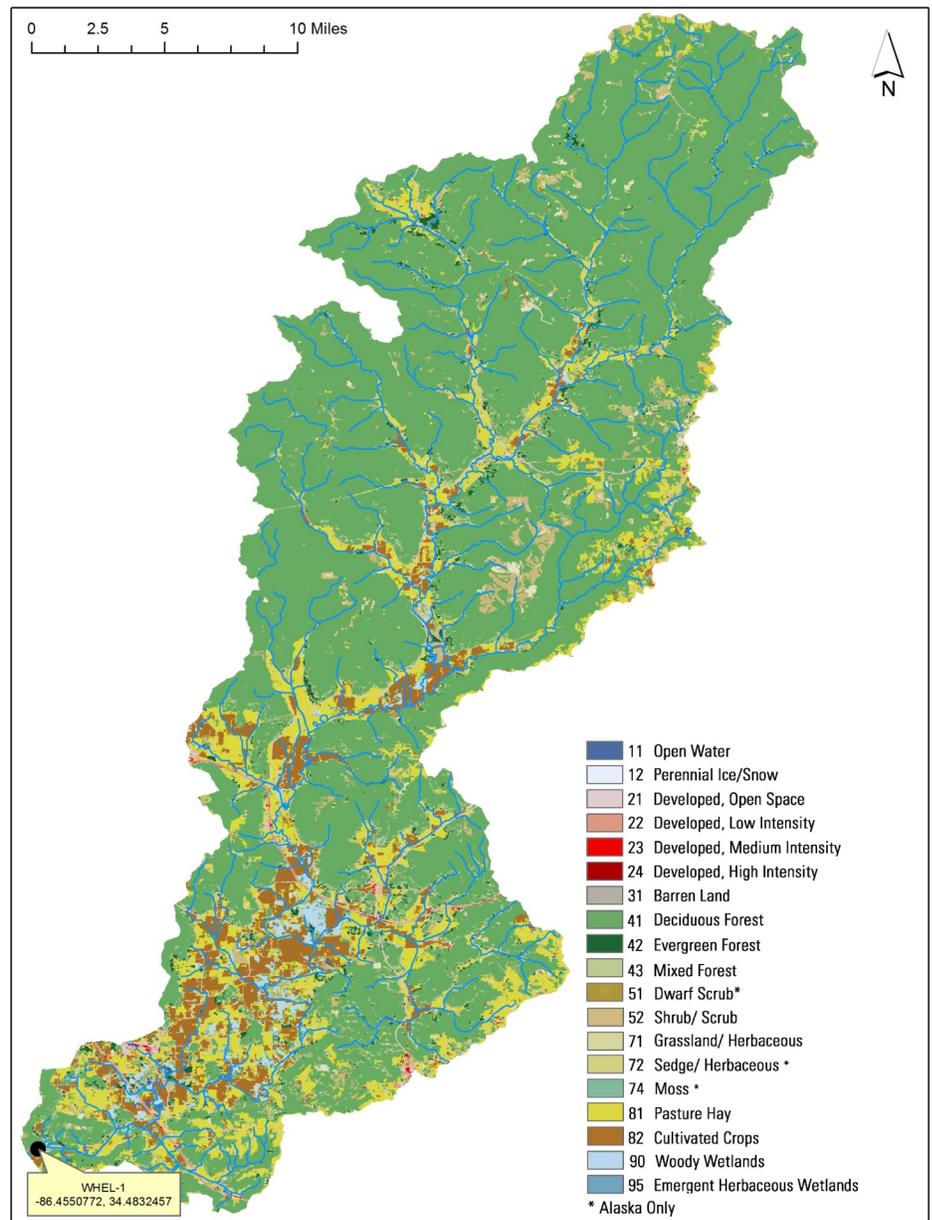


Figure 3. Land use within the Paint Rock River watershed at WHEL-1.

The mean growing season TN value declined in 2015 from 2013, to levels comparable with 2003-2009 (Fig. 4). Monthly TN concentrations peaked in August and were similar all other months.

The mean growing season TP concentration in has declined 2003-2015 (Fig. 4). Monthly TP concentrations were generally low and similar April-October.

In 2015, the growing season mean chl *a* value was higher than 2013 (Fig. 4). Monthly chl *a* concentrations were highest in July.

Mean TSI increased in 2015 to near eutrophic conditions. Monthly TSI in Paint Rock R reached eutrophic conditions July-September (Fig. 4).

In 2015, the mean growing season TSS value was similar to 2013 but lower than 2003 (Fig. 5). Monthly TSS concentrations were highest in April and August.

No AGPT sample was collected from Paint Rock River in 2015. Results from 2003-2013 are shown in Table 3.

DO concentrations were below the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) in August (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

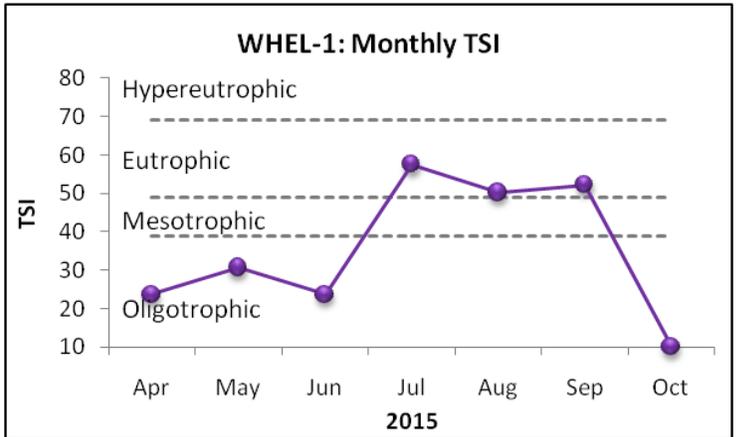
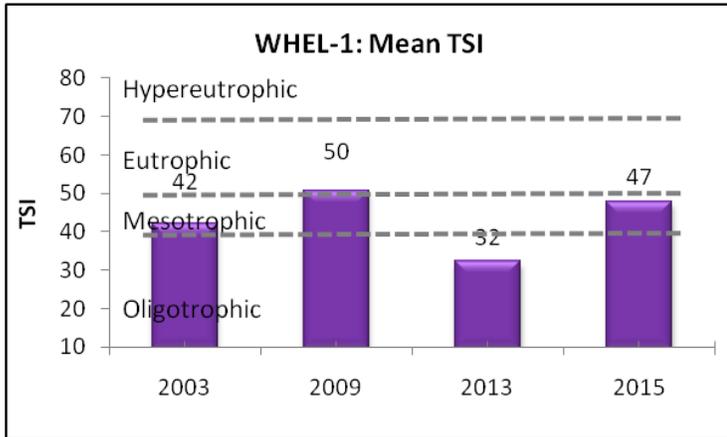
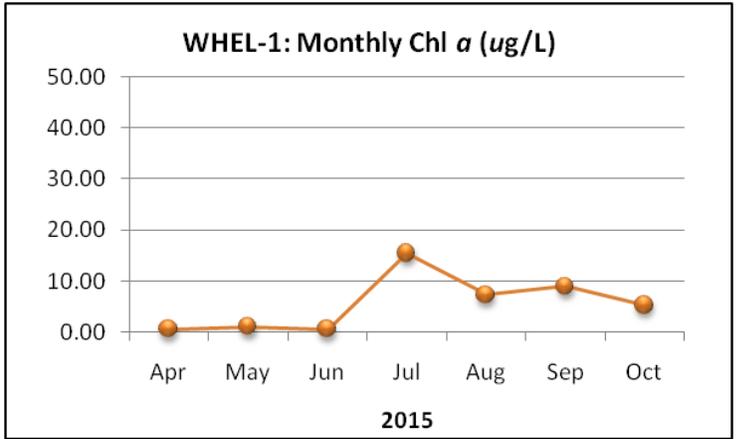
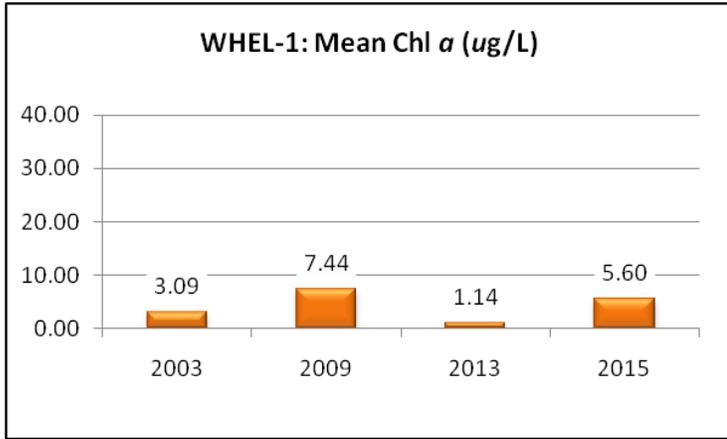
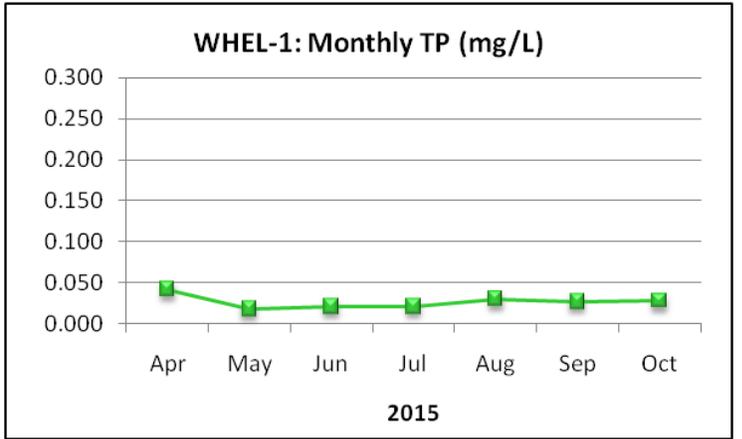
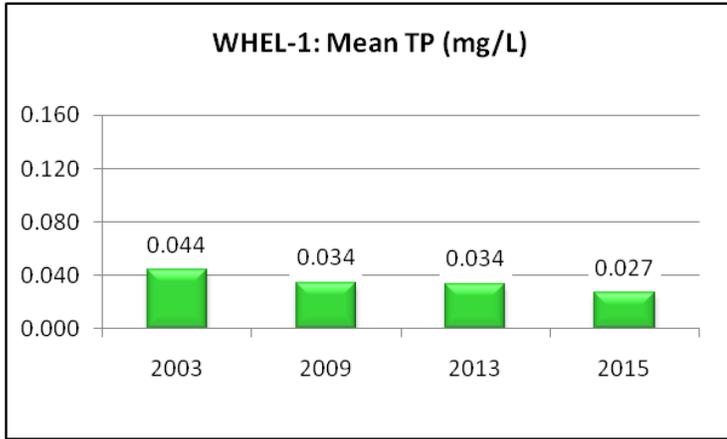
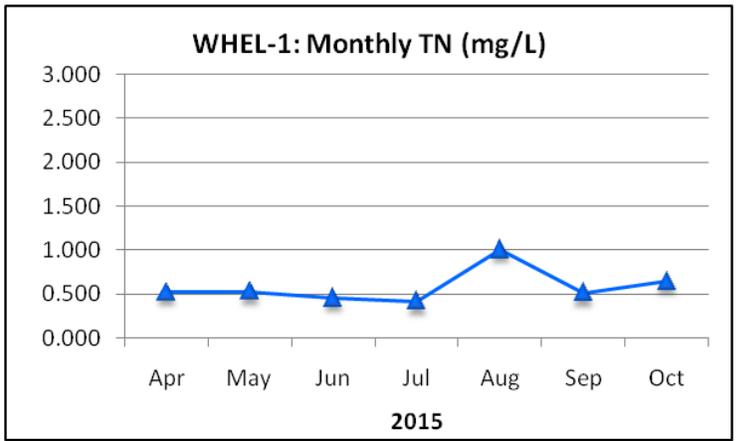
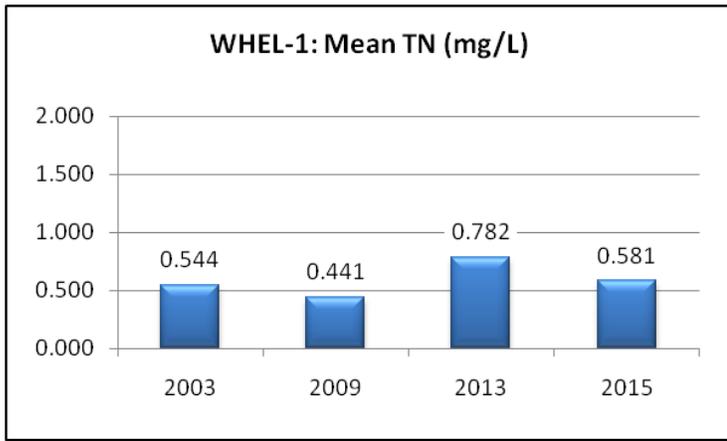


Figure 4. Mean growing season (2003-2015) and monthly (April-October, 2015) TN, TP, chl *a* and TSI measured in the Paint Rock River embayment of Wheeler Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

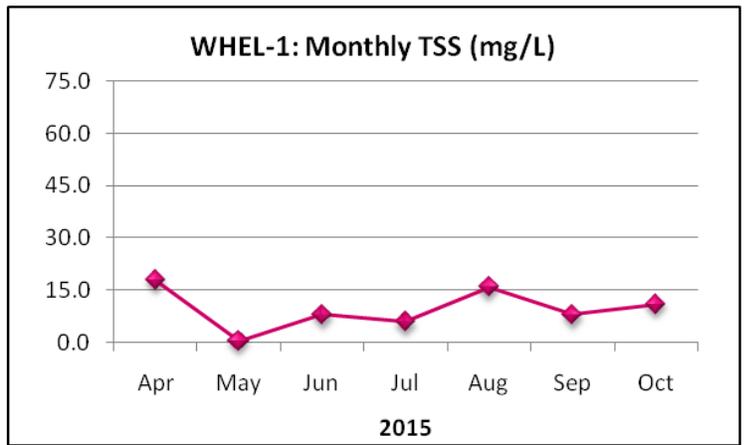
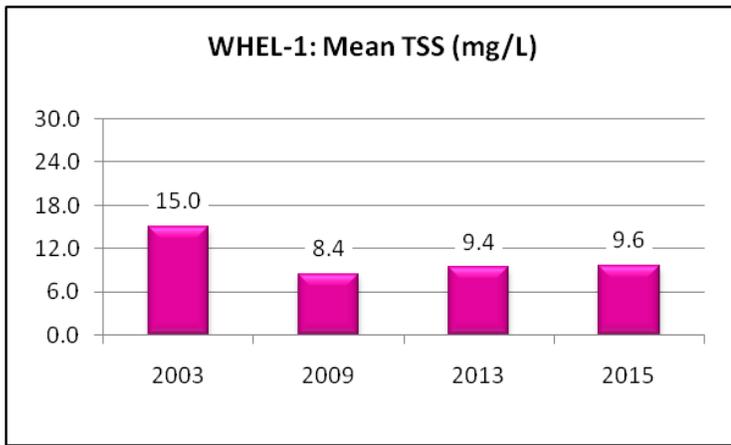


Figure 5. Mean growing season and monthly TSS measured in the Paint Rock River embayment of Wheeler Reservoir.

Table 2. Summary of water quality data collected April-October, 2015. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), mean, and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

WHEL-1	N	Min	Max	Med	Mean	SD
Physical						
Turbidity (NTU)	7	8.0	27.5	9.3	12.2	7.1
Total Dissolved Solids (mg/L)	7	128.0	151.0	133.0	135.9	8.6
Total Suspended Solids (mg/L)	7	< 1.0	18.0	8.0	9.6	6.0
Hardness (mg/L)	4	109.0	139.0	114.5	119.2	13.7
Alkalinity (mg/L)	7	84.7	130.0	105.8	107.4	18.3
Photic Zone (m)	7	1.88	4.02	3.39	3.17	0.72
Secchi (m)	7	0.48	1.40	1.19	1.07	0.34
Bottom Depth (m)	7	4.00	5.28	4.70	4.68	0.38
Chemical						
Ammonia Nitrogen (mg/L) ^J	7	< 0.007	0.092	0.022	0.033	0.032
Nitrate+Nitrite Nitrogen (mg/L)	7	0.137	0.497	0.267	0.304	0.134
Total Kjeldahl Nitrogen (mg/L)	7	< 0.064	0.618	0.326	0.277	0.212
Total Nitrogen (mg/L)	7	< 0.411	1.007	0.517	0.581	0.201
Dissolved Reactive Phosphorus (mg/L) ^J	7	0.006	0.019	0.012	0.012	0.005
Total Phosphorus (mg/L)	7	0.018	0.042	0.027	0.027	0.008
CBOD-5 (mg/L) ^J	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	1.0	7.9	4.6	4.4	2.3
Biological						
Chlorophyll a (ug/L)	7	< 1.00	15.50	5.34	5.60	5.56
E. coli (col/100mL) ^J	3	5	20	11	12	7

J= one or more of the values is an estimate; N=# samples.

Table 3. Algal growth potential test results (expressed as mean MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

Year	Mean MSC	Limiting Nutrient
8/19/2003	1.22	PHOSPHORUS
8/18/2009	1.54	PHOSPHORUS
8/20/2013	4.12	PHOSPHORUS

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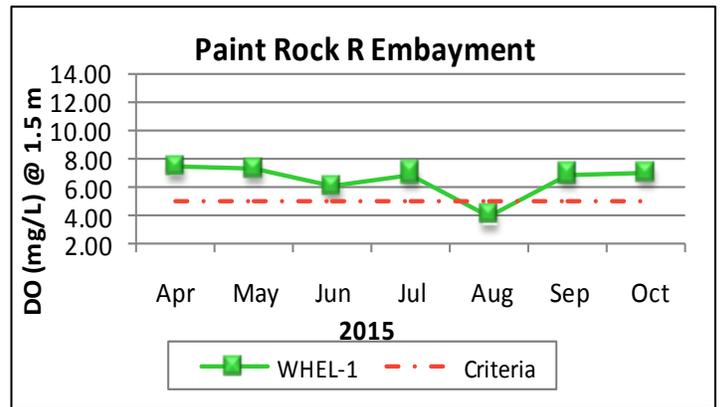


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Paint Rock R embayment station of Wheeler Reservoir collected April-October 2015. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

REFERENCES

- ADEM. 2015. Standard Operating Procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.
- ADEM. 2013. Quality Management Plan (QMP) for the Alabama Department of Environmental, Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.
- ADEM. 2012. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 78 pp.
- ADEM. 2012. State of Alabama Water Quality Monitoring Strategy June 19, 2012. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 88 pp. <http://www.adem.alabama.gov/programs/water/wqsurvey/2012WQMonitoringStrategy>
- Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.09). 2010. Specific Water Quality Criteria. Water Quality Program. Chapter 10. Volume 1. Division 335-6.
- Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.11). 2010. Water Quality Criteria Applicable to Specific Lakes. Water Quality Program. Chapter 10. Volume 1. Division 335-6.
- Carlson, R.E. 1977. A trophic state index. *Limnology and Oceanography*. 22(2):361-369.
- Raschke, R.L. and D.A. Schultz. 1987. The use of the algal growth potential test for data assessment. *Journal of Water Pollution Control Federation* 59(4):222-227.